From the Third Medical Clinic of the Kioto Imperial University.
(Director: Prof. Toshikazu Mashimo, M. D.)

The Accidental Murmur Occurring After the Bodily Exercise in the Normal Heart.

By

Junichiro Yoshioka.

(Received for publication Aug. 15, 1931.)

The heart sounds of the normal heart are not always constant. For instance, the first and the second sound are considerably intensified and the first sound is changed into a systolic murmur after moderate exercise, when the heart is beating vigorously. But such a phenomenon is merely temporary and the heart sounds recover their proper characters in a few minutes.

The writer has investigated these phenomena in thirty healthy persons who had quite normal heart sounds when at rest, and examined these changes in the auscultatory characters by comparing the records obtained in a state of rest and immediately after moderate exercise, when the heart was beating vigorously.

Results of the Experiments.

Twenty eight cases of the experiments were selected and the data of each case are shown in the table.

	Interval between the beginning of the apex beat and that of ejection		Duration of systole		Duration of diastole		Duration of the first section of the principal part		Duration of the second section of the principal part		Duration of the whole principal part		Duration of the whole first sound	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after
1	6.5	5.5	31.5	29	35	17.5	3	3	4	8	7	11	—	—
2	7	6.5	31	27	50	26	3	2	4	9	7	11	20	—
3	5	4.5	31	22	49	27	2.5	2.5	4	7.5	6.5	10	16	16.5
4	5	5	32	26	43	30	2.5	2.5	2.5	5.5	5	8	11	12
5	5.5	5	30	27	38	28	2.5	2.5	2.5	4.5	5	7	17	17
6	5	4.5	23	26	38	28	2.5	2.5	2	4.5	4.5	7	12.5	14.5
7	6	4.5	30	27	40	30	2	2.5	2	7	4	9.5	14	14
8	5	4	33	33	46.5	36.5	1.5	1.5	2.5	3	4	4.5	14.5	15
9	6.5	5	30	26.5	45	37	2.5	2.5	1.5	5.5	4	8	18	20
10	6	5.5	33	32	59	54	3	2.5	2	5.5	5	8	13.5	15.5
11	6	6	30	30	49	45	1.5	1.5	2.5	6	4	7.5	12	19

	Interval between the beginning of the apex beat and that of ejection		Duration of systole		Duration of diastole		Duration of the first section of the principal part		Duration of the second section of the principal part		Duration of the whole principal part		Duration of the whole first sound	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after
12	6 5	6.5	32	33	50	46	2.5	2.5	1.5	5	4	7.5	—	—
13	6.5	6.5	29	29	31	29	1.5	1.5	3	3	4.5	4 5	14	18
14	5	5	28	24	25	25	1.5	2.5	6	6	7.5	8.5	16	16
15	5	5	30	28	32	32	2.5	2.5	4.5	4.5	7	7	12	16
16	5.5	5	24	12	24	24	2.5	2.5	2.5	4	5	6.5	11	15
17	6	5	31	32	39	88	2.5	2	3	11	5.5	13	18	21
18	6	7.5	34	36	40	64	1.5	2	4.5	4.5	6	6.5	15	15
19	4.5	6	32.5	33.5	41.5	62	1	2	6	6.5	7	8.5	15	16
20	4.5	5	30.5	34	56	78.5	2	2	5	13	7	15	—	—
21	5	5.5	32	33	58	83	2.5	3	3	3	5.5	6	18	21
22	7	6.5	32.5	29.5	34.5	39	1.5	2	3	4	4.5	6	16.5	16.5
23	4.5	4.5	30	34	54	61.5	2	2	4.5	4.5	6.5	6.5	—	—
24	5	6	33	35	59	66	2	2.5	3	6	5	8.5	14	16
25	7.5	7	31.5	34	45	48	1	1	3	7	4	8	13	13
26	6	6	31.5	31.5	61	64	3	3	3	5	6	8	—	—
27	6	6	28	29	40	42	2	2	4	6	6	8	14	16
28	5	6.5	35	33	64	60	2	3	3	6	5	9	15	16.5

As shown in the table, the rate of the heart beat was altered variously after exercise and at the same time the duration of each cardiac phase showed various changes. Sixteen of the cases showed increase in the heart rate and the other cases decrease. The interval between the commencement of the apex beat and that of the ventricular ejection, —the period of rising tension in the ventricle before the commencement of ejection —was shortened when the heart rate increased, with the exception of two cases which did not show any change, but in most cases in which the heart rate was decreased, it was prolonged slightly. The duration of the ejection phase was shortened in most cases when the heart rate increased, but it was prolonged in cases of decrease. But the heart beat became considerably more vigorous in all cases.

As is shown in the figures, the most significant and conspicuous changes in the record were observed in the first sound, while the second sound did not show any conspicuous variety except that the amplitude and the duration of the principal part were increased.

The record of the first sound after exercise, showed remarkable increase in the amplitude and the duration. The time relation of the commencement of the initial part to the apex beat was not changed, but in a few cases, they appeared a little earlier than in the state of rest. This

Fig. 1.

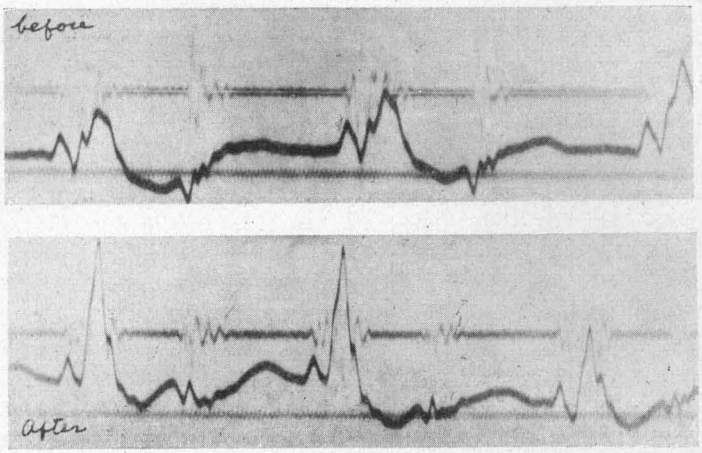
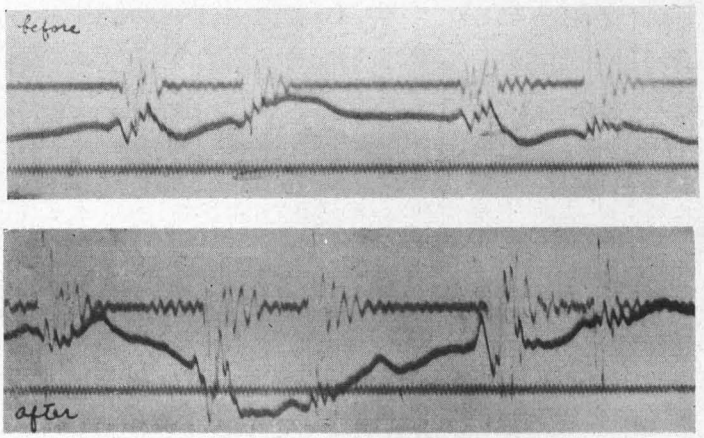


Fig. 2.



part showed a slight increase in amplitude. The vibrations of the principal part showed a considerable increase in amplitude. But the duration of the first section of the principal part did not increase markedly, while the second section of the principal part showed a marked prolongation, and at the same time showed a crescendo form. The vibrations in this part became more irregular owing to the superposition of rather prominent rapid vibrations which were not significant in the resting state. These rapid vibrations were observed also in the final part, so that, the transition from the principal part to the final was more indistinct, and in not a few cases, the irregular vibrations of the final part occupied the whole systole.

Hence, the features of the crescendo vibrations in the ejection phase resembled the vibrations of the murmur in aortic stenosis. But the whole

shape of the first sound was different from that of the murmur in aortic stenosis, because the first sound after exercise showed prominent vibrations of the first section of the principal part, equally to the second section.

In short, the accidental murmur of the normal heart occurring after exercise, was characterised by the prominence of the principal part, especially by a crescendo form of the second section.

Bibliography.

1) *Gerhartz*, Zeitschr. f. klin. Med., **97**, 6 (1923).
2) *Schütz*, Zeitschr. f. d. ges. exper. Med., **67**, 751 (1929).
3) *Schütz*, Zeitschr. f. Biol., **89**, 353 (1930).
4) *Hess*, Deutsch. Arch. f. klin. Med., **132**, 69 (1920).